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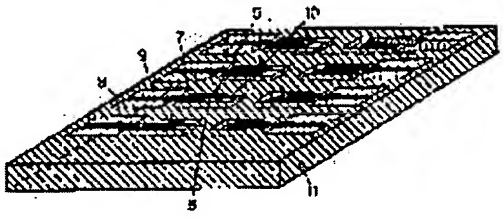
(54) METHOD AND DEVICE FOR RECORDING/REPRODUCING INFORMATION

(57)Abstract:

PROBLEM TO BE SOLVED: To attain high density recording/reproducing with a needle such as STM, etc., by constituting a recording head with plural needles connected to a signal drive circuit and a signal detection circuit formed on the same substrate.

SOLUTION: The needles 5 are formed on a thin beam 6, and are connected to the signal drive circuit 8 and the signal detection circuit 9 electrically by an electrode 7. The needles 5, the signal drive circuit 8 and the signal detection circuit 9 are formed on the same substrate 11, and they constitute the recording head. Thus, the wiring from the signal drive circuit 8 and the signal detection circuit 9 are integrated and shortened extremely, and since inductance is reduced extremely, high speed recording/reproducing becomes possible.



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CLAIMS

[Claim(s)]
[Claim 1] In the recording device which comes to provide a record medium, a recording head, and recording head migration equipment Said recording head was electrically connected to the signal drive circuit and signal detector which were formed on the same substrate. The information record regenerative apparatus which considers at least one end as the configuration which consists of two or more probes formed in a part of front face of the beam fixed to said substrate, and is characterized by the number of trucks on said record medium which said two or more probes move relatively at the time of record or playback turning into plurality.
[Claim 2] In the recording device which comes to provide a record medium, a recording head, and recording head migration equipment Said recording head consists of two or more probes electrically connected to the signal drive circuit and signal detector which were formed on the same substrate. The information record regenerative apparatus which considers as the configuration fixed to said substrate respectively through the submigration equipment to which said probe changes the height from said substrate of the point in each, and is characterized by the number of trucks on said record medium which said two or more probes move relatively at the time of record or playback turning into plurality.
[Claim 3] The information record regenerative apparatus according to claim 2 characterized by submigration equipment consisting of a piezo electric crystal formed in the height direction of a probe, and two electrodes which face across the both ends.
[Claim 4] The information record regenerative apparatus according to claim 3 characterized by having formed the beam which fixed at least one end to the substrate between the electrode surface by the side of the probe of a piezo electric crystal, and each probe, and forming a probe in said a part of beam.
[Claim 5] Itself by which submigration equipment fixed to the substrate at least one end by which the each probe was formed in the part on a front face is constituted from a conductive ingredient. Or two or more beams or plates in which the conductive thin film was formed on the front face by the side of the substrate side are provided. In said said movable electrode and substrate side side which counters, said a part of substrate front face itself is constituted from a conductive ingredient. Or the information record regenerative apparatus according to claim 2 characterized by making into a driving source electrostatic force which possesses the counterelectrode which forms a conductive thin film in the front face of said substrate, and grows into it, and is generated by electrical-potential-difference impression between said movable electrodes and said counterelectrodes.
[Claim 6] An information record regenerative apparatus given in the 1-5th either of the claims characterized by arranging two or more probes in the shape of an array, and only for the include angle of the tangential direction of the record/regenerative track with which the probe near [said] an array center section touches said record-medium side inboard to a some being able to shift the 1st direction near the tangential direction of the record/regenerative track on the record medium of the list of the probe of said array, and arranging.
[Claim 7] An information record regenerative apparatus given in the 1-6th either of the claims characterized by impressing an electrical-potential-difference pulse between each of a record medium

and said probe by the signal drive circuit, making said record-medium surface part produce resistance change, and recording an information bit.
[Claim 8] An information record regenerative apparatus given in the 1-6th either of the claims characterized by recording an information bit by impressing an electrical-potential-difference pulse between each of a record medium and said probe by the signal drive circuit, and making said record-medium front face produce concavo-convex form status change-ization.
[Claim 9] An information record regenerative apparatus given in the 1-8th either of the claims to which a probe, and the drive circuit and signal detector electrically connected to said probe are characterized by being formed in the same front-face side of a substrate.
[Claim 10] two or more probes, the substrate with which submigration equipment was formed, and the drive circuit electrically connected to said probe -- and -- or an information record regenerative apparatus given in the 1-8th either of the claims to which the subsubstrate with which the signal detector was formed is characterized by being fixed mutually.
[Claim 11] In case a recording head and a record medium move relatively, among two or more probes of said recording head at least one probe It considers as the configuration of the probe arrangement which makes it possible to always detect the truck recognition signal recorded on some trucks on said record medium, and truck arrangement. some trucks on said record medium -- a track address -- and Or said track-address signal which recorded the sector address, or considered as the refreshable configuration, and was detected from said probe, And based on said sector address, the absolute address of the momentary scanning point on said record medium of each probe is computed. The information record playback approach characterized by reproducing original data based on said corresponding absolute address from the information bit which recorded the information bit corresponding to said absolute address of the original data which should be recorded on said instant scanning point, or was reproduced from said instant scanning point.
[Claim 12] The information record playback approach given in the 11th term of a claim characterized by recording a truck recognition signal, a track address, and a sector address on the specific truck on a record medium.
[Claim 13] So that the track address detected from which probe may be in agreement with a desired track address After driving recording head migration equipment and carrying out the coarse adjustment of the recording head to field inboard parallel to a record-medium side, Or drive said recording head migration equipment and said field inboard is made to move said recording head slightly so that the detection output of the truck recognition signal of a specific probe may become in the middle of the migration with max. Claim 11th characterized by performing the tracking of a recording head, or the information record playback approach given in 12.
[Claim 14] The location in the inside of the recording head of the probe to which the detection output of a truck recognition signal serves as max out of two or more probe regenerative signals is pinpointed. From at least one probe applicable to the location computed from said pinpointed probe location to a track address A sector address is reproduced. Said pinpointed probe location and said track address, And from said sector address, the absolute address on the record medium of the instant scanning point is computed and assigned to each probe. From the original data which should be recorded, the information bit corresponding to said absolute address is recorded on said instant scanning point. Or claim 11th characterized by reproducing original data based on said corresponding absolute address from the information bit reproduced from said instant scanning point or the information record playback approach given in 12.
[Claim 15] So that the average of the signal output of the specific probe which detects a truck recognition signal may go into the range of desired Drive recording head migration equipment, and adjust the distance between a recording head and a record medium within the limits of predetermined, and it sets to probes other than said specific probe. Drive each ****** equipment and the point of said probe and the distance between said record-medium front faces are adjusted within the limits of predetermined so that the average of the detecting signal from the probe may go into the range of desired. Claim 11th characterized by holding the drive condition of said recording head migration

equipment and said submigration equipment in periods other than said review time, the information record playback approach given in 12 or 13.

[Claim 16] Drive recording head migration equipment and the distance between a recording head and a record medium is adjusted within the limits of predetermined so that the average of the detecting signal from two or more probes may go into the range of desired. And the inclination of a recording head is corrected so that the distance from said record medium of the point of two or more of said probes may become almost equal by measuring the detection output from two or more probes of the edge of said recording head. So that the average of the detecting signal may go into the range of desired in each probe Each ****** equipment is driven and the tip of said probe and the distance between said record-medium front faces are adjusted within the limits of predetermined. In periods other than said review time The information record playback approach given in the 11-14th either of the claims characterized by holding the drive condition of said recording head migration equipment and said submigration equipment.

[Claim 17] The information record playback approach of a recording device given in the 11-16th either of the claims characterized by impressing bias voltage (or bias current) by the signal drive circuit between a record medium and each probe, and for the signal detector where it connected with said probe electrically detecting the current (or electrical potential difference) which flows to said probe, and considering as a regenerative-signal output.

[Claim 18] The information record playback approach given in the 11-16th either of the claims characterized by carrying out the feedback drive of the submigration equipment fixed of said probe in each, and considering the feedback driver voltage as a regenerative-signal output so that bias voltage (or bias current) may be impressed by the signal drive circuit between a record medium and each probe and the current (or electrical potential difference) which flows to said probe may become a predetermined value.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the super-high density recording device which has two or more record playback sections, and its record approach.
[0002]
[Description of the Prior Art] When the conventional high density recording device is classified according to a record means, there are magnetic recording, optical recording, a magneto-optic recording, and electrography. In this, it is said as an approach of becoming the highest [recording density] that an electrography method is promising. This is an object adapting the equipment called STM (scanning tunneling microscope). STM is equipment which observes the shape of concentration-of-electrons distribution of a surface atom or surface type etc. using the tunnel current which one conductive needle called the probe in which the tip sharpened to atomic order is made to approach a sample side to the distance of atomic size order, and flows in that case. By impressing an electrical potential difference to three actuators fixed to the probe, a probe is moved in three dimension to a sample side, a screen scan is performed and the incorporated data are displayed as an image by computer. Piezo-electric ceramics, such as a PZT (PZT) ceramic, are usually used for the actuator. If the distance on the point of a probe and the front face of a sample is changed, the current which flows to a probe will decrease with the exponential function of distance. If it is made to move, impressing an electrical potential difference between a probe and a sample, and maintaining a probe in fixed height on a sample side, since the tunnel current which flows a probe according to the irregularity in the atomic size order on the front face of a sample and surface electron density distribution will change a lot, very minute irregularity, electron density distribution, etc. can be observed. Moreover, if an electrical potential difference is impressed to an actuator and the distance on a probe and the front face of a sample is uniformly controlled so that the tunnel current which flows a probe becomes fixed, the irregularity of a recording surface can be expressed using actuator applied voltage. Applying this STM to a super-high density record regenerative apparatus is also performed. For example, a pulse-like electrical potential difference (2V) is impressed to an STM probe for 0.3 microseconds to the super-thin film which vapor-deposited the straight chain-like paraffin molecule on the carbon crystal (graphite). The diameter of 0.5nm - 1nm and climax of about height 5nm are produced, and identifying the irregularity of this by STM is performed (others [Matsushige / Kazumi / "whom - Kyoto University succeeds in a principle experiment by 1 million CDs by -one high density of nano size"]: Nikkan Kogyo Shimbun March, 1994 printing [15 4th page] per day). Moreover, in other examples of the approach of applying STM as a record means, crystallize the amorphous semiconductor film to a record medium partially by energization from an STM probe, it is made to produce a phase change, and the technique of using the formation of a form status change and resistance change of the front face as a record bit is proposed. However, after the method of searching the location of a record bit scans an STM probe in the shape of a raster, the approach of finding out from change of a configuration, resistance, etc. is used.
[0003] Moreover, ten cantilevers which consisted of silicon oxide and formed one probe on the point

front face on the metal plate are put in order. The piezoelectric device constituted from a piezo-electric thin film of a zinc chloride is stuck on the front face of each cantilever. In the drawing, the electrode terminal pad which extended the electrode thin film of the upper and lower sides of a piezoelectric device is formed on a metal plate, and the multi-probe sensor equipment considered as the configuration which detects distortion of a cantilever as a current signal is devised (October 5, Heisei 7 Nihon Kogyo Shimbun). Measurement is performed by carrying out horizontal migration of the device under test, contacting a cantilever to a device under test, detecting vertical movement of the probe produced with the irregularity on the front face of a device under test as bending of ten cantilevers (piezoelectric device), and detecting change of the distorted current which flows to a piezoelectric device. Moreover, the report that it is also possible to sag a cantilever according to the piezo-electric effect, respectively, to arrange the height of each probe, and to measure the shape of surface type to coincidence by ten cantilevers is carried by passing a current to a piezoelectric device.

[0004]

[Problem(s) to be Solved by the Invention] When a recording device was constituted using STM, the ** rule of an access rate and the readout rate was carried out with the speed of response of head migration equipment or probe migration equipment etc., and the technical problem that it could not be used for record/playback of high speed data, such as a dynamic image, occurred. moreover , although it be thought by being able to stand these probes in a line in parallel , and perform record/playback of parallel data that more nearly high-speed record/playback of data be possible , having maintain the distance of atomic size order and hold the tip of the probe of two or more STM from a record medium front face , to coincidence , it be required to record / reproduce data , there be no concrete technique about these points , and it be thought that it be difficult . Furthermore, it was difficult to separate minute high-speed signal level/current which flows to a probe from noise voltage/current with high level, such as an electrical signal for the drive of a surrounding noise, for example, a head. In addition, when record bit size tended to realize high density record below submicron one, it was very difficult for the truck location recorded [track address / the signal] to position the probe of a recording head with a sufficient controllability at a high speed.

[0005]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, in the recording device of invention of this application 1st In the recording device which comes to provide a record medium, a recording head, and recording head migration equipment Said recording head was electrically connected to the signal drive circuit and signal detector which were formed on the same substrate. The configuration which considers at least one end as the configuration which consists of two or more probes formed in a part of front face of the beam fixed to said substrate, and makes plurality the number of trucks on said record medium which said two or more probes move relatively at the time of record or playback is used.

[0006] In the recording device of invention of this application 2nd, moreover, a record medium and a recording head, In the recording device which comes to provide recording head migration equipment, said recording head It consists of two or more probes electrically connected to the signal drive circuit and signal detector which were formed on the same substrate. The configuration which considers as the configuration fixed to said substrate respectively through the submigration equipment to which said probe changes the height from said substrate of the point in each, and makes plurality the number of trucks on said record medium which said two or more probes move relatively at the time of record or playback is used.

[0007] submigration equipment consists of a piezo electric crystal formed in the height direction of a probe, and two electrodes which face across the both ends as a desirable mode in the 2nd above-mentioned invention -- or between the electrode surface by the side of the probe of a piezo electric crystal, and each probe, formed the beam which fixed at least one end to the substrate, and the probe was formed in said a part of beam -- further Itself by which submigration equipment fixed to the substrate at least one end by which the each probe was formed in the part on a front face is constituted from a conductive ingredient. Or two or more beams or plates in which the conductive thin film was formed on

the front face by the side of the substrate side are provided. said movable electrode side and said substrate side side which counters -- said a part of substrate front face itself -- a conductive ingredient -- constituting -- and -- or the counterelectrode which forms a conductive thin film in the front face of said substrate, and grows into it is provided, and suppose that electrostatic force generated by electrical-potential-difference impression between said movable electrodes and said counterelectrodes is made into a driving source.

[0008] Moreover, two or more probes are arranged in the shape of an array as a desirable mode in the 1st and 2nd above-mentioned invention, and suppose that only some include angle can shift and the 1st direction near the tangential direction of the record/regenerative track on the record medium of the list of the probe of said array is arranged from the tangential direction of the record/regenerative track with which the probe near [said] an array center section touches said record-medium side inboard.

[0009] Furthermore, it is characterized by impressing an electrical-potential-difference pulse between each of a record medium and said probe by the signal drive circuit, making said record-medium surface part produce resistance change in above-mentioned this application 1st and the recording device of the 2nd invention, and recording an information bit. Furthermore, it is characterized by recording an information bit by impressing an electrical-potential-difference pulse between each of a record medium and said probe by the signal drive circuit, and making said record-medium front face produce concavo-convex form status change-ization. Moreover, the thing for which a probe, and the drive circuit and signal detector electrically connected to said probe are characterized by being formed in the same front-face side of a substrate as a desirable mode, furthermore, two or more probes, the substrate with which submigration equipment was formed, and the drive circuit electrically connected to said probe -- and -- or it is desirable that the subsubstrate with which the signal detector was formed was fixed mutually.

[0010] Next, in case a recording head and a record medium move relatively, the record playback approach of invention of this application 3rd At least one probe considers as the configuration of the probe arrangement which makes it possible to always detect the truck recognition signal recorded on some trucks on said record medium, and truck arrangement among two or more probes of said recording head. some trucks on said record medium -- a track address -- and Or said track-address signal which recorded the sector address, or considered as the refreshable configuration, and was detected from said probe, And based on said sector address, the absolute address of the momentary scanning point on said record medium of each probe is computed. It is characterized by reproducing original data based on said corresponding absolute address from the information bit which recorded the information bit corresponding to said absolute address of the original data which should be recorded on said instant scanning point, or was reproduced from said instant scanning point.

[0011] Moreover, it is desirable to record a truck recognition signal, a track address, and a sector address on the specific truck on a record medium.

[0012] After driving recording head migration equipment and carrying out the coarse adjustment of the recording head to field inboard parallel to a record-medium side so that the track address especially detected from which probe may be in agreement with a desired track address, it is desirable to drive said recording head migration equipment, to make said field inboard move said recording head slightly so that the detection output of the truck recognition signal of a specific probe may become in the middle of the migration with max, and to perform the tracking of a recording head.

[0013] Or as other desirable modes, the location in the inside of the recording head of the probe to which the detection output of a truck recognition signal serves as max out of two or more probe regenerative signals is pinpointed. From at least one probe applicable to the location computed from said pinpointed probe location to a track address A sector address is reproduced. Said pinpointed probe location and said track address, And from said sector address, the absolute address on the record medium of the instant scanning point is computed and assigned to each probe. There is the approach of reproducing original data based on said corresponding absolute address from the information bit which recorded the information bit corresponding to said absolute address on said instant scanning point, or was reproduced from said instant scanning point from the original data which should be recorded.

[0014] Furthermore, so that the average of the signal output of the specific probe which detects a truck

recognition signal may go into the range of desired Drive recording head migration equipment, and adjust the distance between a recording head and a record medium within the limits of predetermined, and it sets to probes other than said specific probe. Drive each ****** equipment and the point of said probe and the distance between said record-medium front faces are adjusted within the limits of predetermined so that the average of the detecting signal from the probe may go into the range of desired. The method of holding the drive condition of said recording head migration equipment and said submigration equipment in periods other than said review time is desirable.

[0015] Or so that the average of the detecting signal from two or more probes may go into the range of desired Drive recording head migration equipment and the distance between a recording head and a record medium is adjusted within the limits of predetermined. And the inclination of a recording head is corrected so that the distance from said record medium of the point of two or more of said probes may become almost equal by measuring the detection output from two or more probes of the edge of said recording head. So that the average of the detecting signal may go into the range of desired in each probe It is also desirable to drive each ****** equipment, to adjust the tip of said probe and the distance between said record-medium front faces within the limits of predetermined, and to hold the drive condition of said recording head migration equipment and said submigration equipment in periods other than said review time.

[0016] As other desirable modes, bias voltage (or bias current) is impressed by the signal drive circuit between a record medium and each probe. the signal detector where it connected with said probe electrically detecting the current (or electrical potential difference) which flows to said probe, and considering it as a regenerative-signal output -- or So that bias voltage (or bias current) may be impressed by the signal drive circuit between a record medium and each probe and the current (or electrical potential difference) which flows to said probe may become a predetermined value There is a configuration which carries out the feedback drive of the submigration equipment fixed of said probe in each, and considers the feedback driver voltage as a regenerative-signal output.

[0017] By forming a probe, a signal drive circuit, and a signal detector on the same substrate The minute detection signal current and the minute electrical potential difference from a probe which form the high impedance circuit are changed into low impedance by the signal detector. Become possible to connect and transmit to the high speed signal transmission line which is low impedance, and ** and the charging time value of the transmission line are shortened. Moreover, since an inductance becomes extremely small when wiring from a signal drive circuit and a signal detector becomes extremely short by unification, there is an operation which enables high-speed record/playback. Or there is an operation that become possible to become possible to accelerate a signal-transmission track and to reduce a required track number by making the record / regenerative-signal digital-disposal-circuit function by two or more probes to a signal drive circuit and a signal detector, and forming in the same substrate as each probe, consequently to reduce the terminator of the transmission line, and reduction of the power consumption for adjustment termination is attained.

[0018] Moreover, the remarkable effectiveness that it is very easy to eliminate the noise from the outside since it also becomes easy to become possible to form a common shielding ground plane by integrating a signal drive circuit and a signal detector, and to enclose in one shielding case, and record/playback of the high speed signal excellent in the signal-to-noise ratio are attained is demonstrated.

[0019] Furthermore, since the driving signal of this submigration equipment may also be used as a part of record / regenerative signal when forming submigration equipment in the same substrate as a signal drive circuit and a signal detector, the remarkable effectiveness whose record/playback of a high-speed signal strong against a noise are attained is demonstrated like the above in that case.

[0020] Moreover, by making into plurality the number of trucks on said record medium which said two or more probes move relatively at the time of record or playback, record / refreshable amount of information increases to coincidence, identification of the truck address using two or more trucks etc. is attained, and there is an operation that reliability improves rather than the case where single track performs.

[0021] Two or more probes are arranged in the shape of an array. The 1st direction near the tangential

direction of record/regenerative track of the list of the probe of said array moreover, by record-medium side inboard By considering as the arrangement which can shift only some include angle from the tangential direction of the record/regenerative track with which the probe near [said] an array center section touches The truck which two or more probes located in a line in said 1st direction scan by relative displacement of a record medium is separated respectively, and these separated trucks can be made to arrange between the pitches (spacing) of the probe located in a line in the 2nd different direction from the 1st direction of the list of the probe of said array. By considering as such arrangement, there is a remarkable operation whose super-high density record becomes possible [making small extraordinarily record/playback track pitch (spacing)], and is attained from the pitch (spacing) of the probe which actually creates a probe array. Moreover, since it becomes possible to make into less than [size extent of the record bit on a record medium, or it] the pitch of the probe actually scanned by considering as such probe arrangement and truck arrangement structure It becomes possible to consider as the configuration whose probe of one of the probe arrays surely scans the record bit recorded on the record medium also in the condition of not driving recording head migration equipment by relative (rotation) migration of a record medium. Pursue a truck location using the read truck signal, namely, signal processing of the detecting signal of each probe performs apparent tracking. It becomes possible to record / reproduce information in the location on a desired record medium, and is the electrical and electric equipment of recording head migration equipment. - It also becomes possible to ease a mechanical tracking precision or to suppose partially that it is unnecessary.

[0022] The distance from the record medium of these ones of probes by moreover, the thing kept constant by considering as the configuration which forms a probe in a part of front face of the beam which fixed at least one end to said substrate in this application the 1st invention, and forms two or more these If surface-finish precision of a record medium is performed on atomic level, since it will become possible [other probes and the distance of a record medium] to make it the almost same value, the effectiveness of the invention in this application is acquired with an easy configuration.

[0023] Or when two or more probes consider as the configuration fixed to said substrate respectively through the submigration equipment to which the height from the substrate of each point is changed There is an operation which it becomes possible to amend dispersion in the distance from the tip of each probe to a record-medium front face by driving each submigration equipment, and it becomes possible record/reproducing each probe in the optimal condition (distance between probe pair record-medium front faces).

[0024] Especially when it constitutes submigration equipment using a piezo electric crystal, it becomes possible to constitute detailed submigration equipment from an easy configuration. moreover -- or it becomes possible to make thickness change of a piezo electric crystal amplify with a beam, and to enlarge the justification range of a probe by considering as the configuration which formed the beam which fixed at least one end to the substrate between the electrode surface by the side of the probe of a piezo electric crystal, and each probe, and formed the probe in it at a part of this beam.

[0025] Or it becomes possible to carry out submigration equipment with an easy configuration, when it constitutes at least one end from a movable electrode which consists of the beam or plate constituted from a member with the conductivity fixed to the substrate, and a counterelectrode formed in the substrate side which counters this.

[0026] By impressing an electrical-potential-difference pulse between a record medium and a probe by the signal drive circuit, and making a record-medium surface part produce resistance change It becomes possible to record / reproduce information as resistance change by the probe, and there is an operation which becomes possible [recording / reproducing information as formation of a surface type status change of a record medium] with a means to make said record-medium front face produce concavo-convex form status change-ization in electrical-potential-difference pulse impression.

[0027] Moreover, since it is enabled to make the die length of the connection electrode of each between short, and to make stray capacity small by forming a probe, a drive circuit, and a signal detector in the same front-face side of a substrate, there is an operation to which high-speed record / playback becomes easy.

[0028] next, in the record playback approach of invention of this application 3rd In case a recording head and a record medium move relatively, among two or more probes of said recording head at least one probe It considers as the configuration of the probe arrangement which makes it possible to always detect the truck recognition signal recorded on some trucks on said record medium, and truck arrangement. some trucks on said record medium -- a track address -- and Or said track-address signal which recorded the sector address, or considered as the refreshable configuration, and was detected from said probe, And based on said sector address, the absolute address of the momentary scanning point on said record medium of each probe is computed. The information bit corresponding to said absolute address of the original data which should be recorded is recorded on said instant scanning point. Or by using the approach of reproducing original data based on said corresponding absolute address from the information bit reproduced from said instant scanning point Since it becomes possible to surely detect a truck recognition signal, a track address, and a sector address no matter a recording head may be in what location, there is an operation of becoming possible to record each probe on the absolute location of the purpose on a record medium, and to reproduce based on these data. Furthermore, with this configuration, there is also an operation of becoming possible to perform the next truck positioning on the basis of this, detecting the signal of the truck previously recorded by ******.

[0029] So that the track address especially detected from which probe may be in agreement with a desired track address After driving recording head migration equipment and carrying out the coarse adjustment of the recording head to field inboard parallel to a record-medium side, Or by driving said recording head migration equipment, making said field inboard move said recording head slightly so that the detection output of the truck recognition signal of a specific probe may become in the middle of the migration with max, and performing the tracking of a recording head Since high-speed track-address retrieval is attained and the record playback location precision of the data on a record medium improves, there is a remarkable operation that become possible to make record bit size small to an atom and molecule size order, and the fast improvement in recording density is attained.

[0030] Or the location in the inside of the recording head of the probe to which the detection output of a truck recognition signal serves as max out of two or more probe regenerative signals is pinpointed. From at least one probe applicable to the location computed from said pinpointed probe location to a track address A sector address is reproduced. Said pinpointed probe location and said track address, And from said sector address, the absolute address on the record medium of the instant scanning point is computed and assigned to each probe. From the original data which should be recorded, the information bit corresponding to said absolute address is recorded on said instant scanning point. Or by reproducing original data based on said corresponding absolute address from the information bit reproduced from said instant scanning point Without using impaction efficiency adjustment of a mechanical recording head, it becomes possible to apply tracking electrically by signal processing, and there are high-speed record and a remarkable operation of becoming reproducible, more.

[0031] Moreover, so that the average of the signal output of the specific probe which detects a truck recognition signal may go into the range of desired Drive recording head migration equipment, and adjust the distance between a recording head and a record medium within the limits of predetermined, and it sets to probes other than said specific probe. Drive each ****** equipment and the point of said probe and the distance between said record-medium front faces are adjusted within the limits of predetermined so that the average of the detecting signal from the probe may go into the range of desired. Since the average of the distance between a record-medium front face and each probe is maintainable to a desired value in periods other than said review time by holding the drive condition of said recording head migration equipment and said submigration equipment There is an operation of becoming possible by making the shape of toothing of the resistance change on the front face of a record medium or a front face into recording information to carry out discernment detection.

[0032] Or so that the average of the detecting signal from two or more probes may go into the range of desired Drive recording head migration equipment and the distance between a recording head and a record medium is adjusted within the limits of predetermined. And the inclination of a recording head is corrected so that the detection output from two or more probes of the edge of said recording head may

be measured and the distance from said record medium of the point of two or more of said probes may become almost equal. So that the average of the detecting signal may go into the range of desired in each probe Each ****** equipment is driven and the tip of said probe and the distance between said record-medium front faces are adjusted within the limits of predetermined. In periods other than said review time Since the average of the distance between a record-medium front face and each probe is maintainable to a desired value like the above by holding the drive condition of said recording head migration equipment and said submigration equipment There is an operation of becoming possible by making the shape of toothing of the resistance change on the front face of a record medium or a front face into recording information to carry out discernment detection.

[0033]

[Embodiment of the Invention] The example of the invention in this application is explained based on a drawing.

[0034] First, drawing 1 is the mimetic diagram showing one example of the recording device which is this application the 1st or 2nd invention. In drawing 1 , the record medium 1 is revolving around a medial axis, onto this front face, a slight distance is separated and a recording head 2 moves. The recording head 2 has composition which moves to radial [of a record medium 1] with recording head migration equipment 3. Two or more probes are formed in the record-medium 1 side of a recording head 2, and a truck 4 is formed in the front face of a record medium 1 in case these record by moving near the front face of a record medium 1. Head justification device supporter 3b which drives recording head migration equipment 3 as an example by drawing 1 with the gearing which meshed to motor 3a and its driving shaft, a belt, etc., Migration controller 3c which performs very small justification of a direction parallel recording head in the migration direction of head justification device supporter 3b which consists of piezo electric crystals installed in the edge, It consists of head vertical-drive section 3e which controls migration of a recording head 2 in a direction perpendicular to 3d of head support plates fixed to it, and the field of a record medium 1, and the inclination of a recording head 2. If it is by the object which has other same functions, of course, it will not be the object limited to these. Feedback control of these recording head migration equipments is carried out based on the regenerative signal from a recording head, and access to a recording track and tracking control are made.

[0035] Surface type status change-ization of the irregularity to which the part in which the probe 5 of the record/regenerative track on a record medium 1 is approaching by impressing an electrical potential difference by the signal drive circuit, and pouring a tunnel from the point of a probe 5 between probes 5 and record media 1 with the sharp tip of a recording head takes place by change of surface electrical resistance, and record of an information bit takes place owing to the Joule's heat takes place, and record which is an information bit is performed. The playback in the information record by surface-electrical-resistance change reproduces and outputs the information bit which detected the current (or electrical potential difference) which impresses the electrical potential difference (or current) which is extent to which change does not take place to record-medium 1 front face, and flows from a probe 5 to a record medium 1 by the signal detector, and was recorded by the value between the probe 5 and the record medium 1. Moreover, the playback in the information record by the formation of a surface type status change Between a probe 5 and a record medium 1, the electrical potential difference (or current) which is extent from which change does not take place to record-medium 1 front face is impressed. In case the distance of a probe 5, and a record / regenerative-track maximum front face approaches, a current detects the current (or electrical potential difference) which flows from a probe 5 to a record medium 1 by the signal detector using what is flowed greatly (or an electrical potential difference becomes low), and reproduces and outputs the information bit recorded by the value. Or submigration equipment is driven in the recording device of invention of this application 2nd. Since it can carry out as [become / the current (or electrical potential difference) which flows a probe 5 / fixed] (distance with a probe 5 will be made regularity according to the irregularity on the front face of a record medium when surface electrical resistance is the same), impressing a fixed electrical potential difference (or current) to a probe 5 The electrical potential difference or current which drives this submigration equipment can also be considered as a signal detection output.

[0036] In addition, the signal drive circuit which uses by this application 1st - the 3rd invention, and a signal detector may include the function of a data register of memorizing the data which should carry out record playback outside the circuit which realizes the single function which records bit data and is reproduced from one probe, the address signal processing circuit function on a record medium detect a location absolutely, the interface-circuitry function of performing data transmission with an external device, etc.

[0037] One concrete example of the recording head used for the recording device of invention of this application 1st is shown in drawing 2 . In order to make it legible by a diagram, it has dared change the horizontal and vertical dilation ratio. In drawing 2 , a probe 5 is formed on the thin beam 6, and the probe 5 is electrically connected to the signal drive circuit 8 and the signal detector 9 by the electrode 7. In the probe 5, the signal drive circuit 8, and the signal detector 9, it is formed on the same substrate 11 and the recording head 2 is constituted.

[0038] Drawing 3 and drawing 4 are the cross sections showing the example of the configuration of the beam used for drawing 2 . In drawing 3 , the one end section is being fixed on the substrate 11, and, as for the beam 6, the probe 5 is formed on the other end of the beam 6. In drawing 4 , the probe 5 is formed on the doubly-supported beam 13. In drawing 3 and drawing 4 , although a probe 5 reaches signal drive circuit 8 with the electrode 12 of the thin film configuration formed on a beam 6 or 13 and is not illustrated, it is connected to the signal detector 9. If beams 6 or 13 have the structure where it can bend in the space 10 formed in the substrate 11, it becomes possible to prevent a probe 5 approaching the front face of the record medium 1 of drawing 1 R> 1 too much by bending of this beam, and colliding and it is by change of slight approach distance, it will be the configuration which can maintain an almost fixed probe pair record-medium surface distance. Therefore, it becomes possible by arranging a probe in the shape of an array two or more in this configuration to record two or more information bits on coincidence. Since the width of face of one record / regenerative track 4 is several angstroms - several nm to atomic size order, by shifting a little the direction and the direction of a truck which are located in a line in the migration direction of the record medium of a probe array, it becomes possible to make spacing of actual record/regenerative track narrower than probe array spacing, and arrangement of one truck is also possible per one probe. This means that there is an advantage that a record track pitch can be extraordinarily made small rather than the pitch which actually creates a probe.

[0039] The concrete manufacture approach of the recording device invention of this application 1st is as follows. It is appropriate for substrates 1 and 11 to use easy ingredients of processing, such as semiconductor materials, such as Si and GaAs, and glass, a metal. Although the signal drive circuit 8 and the signal detector 9 have substrates 1 and 11 possible also for constituting from a thin film transistor (TFT) in addition to the case of a semiconductor material substrate, the configuration of forming on another semi-conductor substrate and fixing to substrates 1 and 11 can demonstrate rapidity more. It is more desirable to perform production of the signal drive circuit 8 or the signal detector 9 before formation of beams 6 and 13 or a probe 5 from a viewpoint on micro processing. Pattern formation of the metal thin films, such as silicon nitride, a nitride of SiO2 grade, an oxide film or gold, and a tungsten, molybdenum, is carried out, and a beam 6 or formation of 13 produces them, before forming space 10. A probe (space 10 has not opened yet) 5 and an electrode 12 are formed on the beam. After formation of a probe 5 carrying out several micrometer spin coat of the positive type photoresist film, depositing mask thin films, such as a metal thin film, on it and making the detailed hole of sub mum - number mum in the predetermined location of a beam at a mask thin film, the bigger hole in the lower part of the hole where a mask thin film is detailed than it is made in the resist film by exposing and developing ultraviolet rays from on a mask thin film. After carrying out vacuum deposition of the hard metal used as the ingredient of a probe 5, for example, a tungsten, molybdenum, the niobium, etc. from besides, the probe 5 with a sharp tip is formed in the predetermined location on a beam 6 and 11 by being immersed in solvents, such as an acetone, and removing a photoresist. Furthermore, after oxidizing a probe front face, it is also possible to make the tip of a probe 5 sharp by the well-known method of removing only a surface oxide film. After forming a probe 5 in this way, etching removal only of the part of space 10 is carried out alternatively. As for this, the well-known method of using the

difference of the etch rate by the quality of the material is effective. Under the present circumstances, it is also useful to protect a probe 5, the signal drive circuit 8, and signal detector 9 grade by a resist etc. in advance depending on the case. For example, in the case where Si substrate is used, as Si etchant, if HF:FNO3 (1:200) is used, only space 10 part will be etched, without etching the charge of a truss of SiO2 or Si3N4 grade. Moreover, the gaseous-phase chemical etching by reactant gas is used similarly. If CCl4 and Cl2 grade are used as etching gas of Si, the selective etching of only space 10 part will become possible, without etching the charge of a truss of SiO2 or Si3N4 grade. Thus, the recording head which is one component of invention of this application 1st possessing two or more probes can be manufactured.

[0040] Next, one concrete example of the recording head used for the recording device of invention of this application 2nd is shown in drawing 5 . In drawing 5 , the probe 25 is being fixed on the substrate 21 through submigration equipment 22. In the example of this drawing, a probe 25 is formed on the thin beam 26, and is electrically connected to the signal drive circuit 28 and the signal detector 29 by the electrode 27. It is formed on the same substrate 21 in the probe 25, the signal drive circuit 28, and the signal detector 29. Fixed formation of the end is carried out on the front face of a substrate 21, and the beam 26 is being fixed in the middle of the beam 26 by the substrate 21 through submigration equipment 22. The beam 26 is formed so that vertical vibration can be freely carried out in the space 30 prepared into the substrate 21, and it performs minute impaction efficiency of the upper and lower sides of the probe 25 formed on the beam 26 by bending up and down with submigration equipment 22. The submigration equipment drive circuit 23 formed on the substrate 21 front face performs the drive of submigration equipment 22. These submigration equipments are formed in each of each probe 25, and have the composition that the vertical location (distance from a record medium) of each probe can be adjusted according to an individual.

[0041] Drawing 6 , drawing 7 , and drawing 8 are the cross sections showing the concrete example of the configuration of the submigration equipment shown in drawing 5 , and a probe. Even in these drawings, in order to make it legible, it has dared change the horizontal and vertical dilation ratio. In drawing 6 , the beam shows the configuration of the recording head which is not used. Lower electrode 34a is formed on a substrate 31, the piezo electric crystal 33 is formed on it, electrode 34b is formed in the upper part, and submigration equipment 32 is constituted. On up electrode 34b of submigration equipment 32, the probe 25 connected with the electrode 35 on both sides of the dielectric 36 at it is formed. Lower electrode 34a of submigration equipment 32 and the wiring 37 pulled out from up electrode 34b are connected to the submigration equipment drive circuit 23. Moreover, from the electrode 35 connected to the probe 25, wiring 38 is pulled out and it connects with the signal drive circuit 28 and the signal detector 29. If an example is given as an example of a piezo electric crystal 33, the PZT (PZT) ceramics etc. can be used. Its piezoelectric constant is electrical-potential-difference impression of 10V, when thickness of a piezo electric crystal 33 is set to 10 micrometers, for example, since PZT is 250x10-12 m/V extent, and as for telescopic motion of the thickness direction, about 2.5nm is obtained. That is, accommodation of vertical movement of an about 2.5nm probe is attained. Of course, if thickness of a piezo electric crystal is thickened with 100 micrometers further, for example, the magnitude of the telescopic motion at the time of the same electric-field (100V electrical potential difference) impression will become large with about 25nm. These dimensions are good to decide from a viewpoint of a system design. What was started from the ceramic ingredient is stuck on a substrate, or a piezo electric crystal can also be formed according to a well-known thin film process.

[0042] Next, the example of other submigration equipments is shown in drawing 7 . All over the space 43 formed in the substrate 41 by etching, the submigration equipment 42 which consists of a piezo electric crystal 49 and electrodes 44a and 44b of the upper and lower sides is being fixed. On up electrode 44b of submigration equipment 42, the electrode 45 is formed a beam 48 and on it. Fixed formation of the end is carried out on the front face of a substrate 41, and, as for the beam 48, the probe 25 is formed on the surface of many items. Wiring 47 is connected to electrode 44b on submigration equipment 42, and it connects with the submigration equipment drive circuit 23 with lower electrode 44a. The electrode 45 electrically connected to the probe 25 is connected to the signal drive circuit 28

and the signal detector 29. As an ingredient of a beam 48, the ingredient of SiO2 or Si3N4 grade is suitable. Moreover, about the piezo electric crystal ingredient, PZT which is in the above-mentioned concrete example is suitable. The beam 48 has the structure where it can bend in space 43, it is generated by the electrical potential difference impressed to the piezo electric crystal 49 of submigration equipment 42, and bending of this beam has composition which amplifies the up-and-down variation rate produced to the power point (piezo electric crystal node) of a beam with the distance by the supporting point and point of application (probe location). In this example of a configuration, when the same piezo electric crystal ingredient is used, it has the composition that the variation rate of the bigger upper and lower sides than drawing 6 is obtained, by the same impression electric field.

[0043] a book -- the manufacture approach of the recording head in a concrete example is as follows. It is appropriate for a substrate 41 like this application the 1st invention to use easy ingredients of processing, such as semiconductor materials, such as Si and GaAs, and glass, a metal. It is more desirable to perform production of the signal drive circuit 28 or the signal detector 29 before formation of a beam 48 or a probe 25 from a viewpoint on micro processing. By next, space 42 is formed by the well-known etching approach. After carrying out pattern formation of the lower electrode 44a, piezo electric crystal thin films, such as PZT and ZnO, are formed, and pattern processing is carried out. Or it is also possible to stick and form a bulk piezo electric crystal ingredient. Then, the part which is opening space 42 is returned with the easy ingredient of etching. A production process will become easy if this charge of backfill uses the organic substance, such as a resist. In this case, if the spin coat of the resist is carried out, for the viscosity of a resist, and surface tension, the resist of thickness almost equal to the thickness which a resist is buried with all the clearances between space 43, and is formed on other front faces of a substrate 41 also on it will be formed, and flattening of the whole substrate will be carried out. The resist front face is deleted until the front face of a piezo electric crystal 49 exposes this by the oxygen plasma, Ar ion milling, etc. A metal-electrode thin film is formed on the front face which the piezo electric crystal 49 exposed, and a photograph process performs pattern formation of electrode 44b. After an acetone removes a resist, backfilling is again performed by the resist, a resist is etched, and electrode 44b is exposed. Then, it forms with the well-known mask vacuum deposition which stated the probe 25 in the example of the 1st invention after forming SiO2 and Si3N4 thin film by CVD and forming the electrode thin film 45 on it, and after an acetone removes a resist mask, pattern formation of a beam 48 and the electrode 45 is carried out to a photograph process by selective etching. When an acetone removes a resist, the principal part of drawing 7 will be formed. Furthermore, an electrode 45 forms a connection electrode in a subsequent process, and connects it to the signal drive circuit 28 and the signal detector 29. Moreover, electrode 44b of submigration equipment 42 is connected to the submigration equipment drive circuit 23 by wiring 47.

[0044] In addition, it is possible to use, if it is the ingredient which can etch only it as a charge of backfill without etching a substrate 41, a piezo electric crystal 49, an electrode 44a ingredient, a beam 48, and probe 25 grade outside.

[0045] Thus, the recording head which is one component of invention of this application 2nd possessing two or more probes can be manufactured.

[0046] Next, the 3rd concrete example of the recording head used for the recording device of invention of this application 2nd is shown in drawing 8 . Backfilling is performed, after forming space 53 in a substrate 51 by etching and forming earth electrode 57 pattern in this drawing. In this case, as explanation of above-mentioned drawing 7 described as a charge of backfill, ingredients, such as ZnO, can also be used out of a resist. In this case, only the thickness for the depth of space 53 carries out the volume of the ZnO thin film by the spatter, and etching removal of the substrate surface part to which a beam 58 is connected is carried out. Then, a probe 25 is formed for a counterelectrode 56 using deposition and carry out pattern formation, deposit ingredient [of a beam 58], and thin film of SiO2 or Si3N4 grade on it, form metal thin film on it, and according to resist mask like the above-mentioned mask vacuum deposition. Pattern formation is performed after that and a beam 58 and an electrode 55 are formed. An electrode 55 carries out pattern formation of the connection electrode further, and connects it to the signal drive circuit 28 and the signal detector 29. The earth electrode 57 and the

counterelectrode 56 form the capacitor, and these constitute submigration equipment 52. It connects with the submigration equipment drive circuit 23, and a probe 25 moves an earth electrode 57 and a counterelectrode 56 to the location where the Coulomb force generated with the electrical potential difference impressed among both and the elastic force of a beam 58 balance. In the case of cantilever structure, the distance from the supporting point (a part for the wall of space 53) of a beam 58 to a release edge (near a probe location) like a beam 58 L, if Young's modulus of the ingredient of h and a beam 58 is set to E for the thickness of a beam 58 and the dielectric constant of V and space 53 is set to epsilon 0 for the electrical potential difference which impresses spacing between electrodes 56 and 57 between d, two electrodes 56, and 57 -- the vertical location of the release edge of a beam 58 -- a variation rate -- y (the vertical location of ** probe variation rate) is given by the formula 1. With this configuration, since y is not dependent on the width of face of a beam 58 only depending on the thickness h of a beam 58, and the structural constant of an electrode spacing d, there are the features that a V pairs of electrical-potential-differences displacement y property can be made with a sufficient controllability, by controlling Thickness h and the electrode spacing d of a beam. In addition, since it becomes about 2.6% of value of a formula 1 in a configuration of that there is a probe in the center of a beam with a doubly-supported beam, cantilever structure like drawing 8 is suitable for the recording head of the invention in this application.

[0047]

[Equation 1]

$$y = \frac{3\epsilon_0 \cdot L^4 \cdot V^2}{E \cdot h^3 \cdot d^2}$$

[0048] Since the Coulomb force per unit area is proportional to the square of electric field, when the same electrical potential difference is impressed to an earth electrode 57 and a counterelectrode 56, Coulomb force becomes stronger as inter-electrode spacing is narrow. for example, in using for the ingredient of a beam 58 Si3N4 formed with the CVD method Since the value of 1.5x1010 N/m2 is acquired, if the Young's modulus uses the electrodes 56 and 55 of 300nm and the upper and lower sides as gold (Young's modulus 7.9x1010 N/m) for the thickness of a beam and the thickness is respectively set to 60nm the time of die-length L of a beam being 10 micrometers -- impression field strength (= V/d) -- 3x104 V/cm -- the vertical location of the probe of a beam 58 -- a variation rate -- y is set to about 6 a little less thannm from a formula 1. As for y, impression field strength is set to about 62nm by 105 V/cm. therefore, the submigration equipment drive circuit which applied voltage is set to each, and 1.5V and 5V, and is constituted from an IC circuit if an electrode spacing d is set to 0.5 micrometers -- a drive -- it can put into the range of an easy value. Thus, the recording head which is one component of invention of this application 2nd possessing two or more probes can be manufactured.

[0049] Next, when a probe which was indicated in the above-mentioned example, the signal drive circuit, and the signal detector have been arranged in the shape of an array, a concrete example [about] is explained using drawing 9 . From on the record-medium side, in drawing which looked at the probe of a recording head, since it is intelligible, drawing 9 changes a dilation ratio on four directions, and has drawn it typically. O mark shows typically the tip location of the probe which scans a record-medium side top in this drawing. Moreover, the line which runs perpendicularly shows typically the locus (almost equal to record playback / truck) drawn in case each probe scans a record-medium side, when a record medium carries out relative (rotation) movement to a recording head. The include angle which ****(ed) to the record-medium side inboard which the tangential direction of the locus on the record medium with which the probe of the center section of the probe array touches, and the 1st direction of the list of the probe of the probe array near the direction accomplish is set to theta, and the pitch of the list of the probe of a direction which is different from p1 in the pitch (spacing) of the list of the probe of the 1st direction of a probe array, and is different from the 1st direction of N individual and a probe array in the line count be set to p2. The include angle of the 1st direction and the 2nd direction to accomplish is set to phi as shown in drawing. By drawing 9 , a probe shows ten lines in the 1st direction, and shows 3 **** poor **** in the 2nd direction. If theta is taken suitably, it is possible to arrange so

that the locus which the probe after the 2nd line next to the head line of each train draws may enter like drawing 9 between the loci which the probe train of a head line draws. If theta is set up like especially the formula 2, spacing of the locus of all probes can be arranged almost equally (when the radius of curvature of a locus is large enough compared with the pitches p1 and p2 of the list of a probe).
[0050]
[Equation 2]

$$\theta = \tan^{-1}\left\{ \frac{W \cdot \sin(\phi)}{(n+1) \cdot L + W \cdot \cos(\phi)} \right\}$$

[0051] At drawing 9 , the probe of the head line of eye the 1st train of a probe array is shown by 81, and it of the head line of eye the 2nd train is shown by 82. The locus 84 of nine (= N-1) books which the probe 83 of the 2nd ****** of the 2nd line and the probe of the line after it draw will be located in a line at equal spacing between the locus 85 which a probe 81 draws, and the locus 86 which a probe 82 draws. Since the smallest locus pitch at this time serves as p2/N, it becomes possible by enlarging N to make an apparent track pitch small. Each of this locus (record/regenerative track) pitch is comparable as the size of a record bit, or it becomes possible to apply tracking by signal processing, without moving a recording head mechanically based on this signal, if a periodic signal, a track address, etc. for tracking are written in one of record/regenerative tracks since all the record bits on a record medium are surely detected by one of probes when smaller than it.
[0052] In addition, in order to realize this configuration, it is also useful to prepare the head regulatory mechanism which makes field inboard rotate the probe array of a recording head to a record medium in 3d of head support plates of drawing 1 etc.
[0053] Next, an example is described about the record playback approach of invention of this application 3rd. Drawing 10 is the mimetic diagram showing arrangement of the truck on the record-medium side which shows one example of the record playback approach of invention of this application 3rd, data, etc. Although the track addresses 62a and 62b and sector addresses 63a, 63b, 64b, and 65a which are recorded and reproduced are formed in some trucks 67 and 68 on a record medium, these are overlapped on a truck recognition signal and this drawing shows the record-medium configuration in which the record data area was formed to other trucks, you may have the composition that a truck recognition signal is recorded on truck where a track address and a sector address are another. Single signalling frequency which is easy to detect in a resonance circuit is sufficient as a truck recognition signal, and a specific bit pattern train is sufficient as it. When a track address and a sector address are overlapped on a truck recognition signal, it is required for both signal to be able to identify easily. In such truck arrangement, even when a recording head is in what kind of mechanical location, in case a recording head and a record medium move relatively, it considers as arrangement whose at least one probe always detects a truck recognition signal among two or more probes. In drawing 10 , this is realizable, if spacing between the probes of the outermost part of the direction (henceforth the truck cross direction) which intersects perpendicularly with the truck of the list of the probe of a recording head carries out more than spacing of the trucks 67 and 68 with which the truck recognition signal was recorded, i.e., spacing of the truck train 66, and sets the minimum interval pitch of the truck cross direction of a probe to 1 for the natural number of a track pitch (spacing). Although these values are decided according to a design matter, it is practically considered to be efficient to take equally the probe pitch and track pitch of the truck cross direction, and to take equally to spacing of the truck train 66 spacing between the probes of the outermost part of the truck cross direction. It cannot be overemphasized that the value of an actual track pitch and actual probe spacing etc. should be decided depending on micro-processing precision.
[0054] If the case where ****** scans a truck 67 top now is assumed, since the vector physical relationship of this probe of a recording head and each probes of other is being fixed, the absolute address on the record medium in the instant scan time of this probe is computable by making into a clock signal fundamental frequency contained in the truck recognition signal detected the track-address signal detected from this probe, and based on said sector address. By adding the relative-position vector

on the recording head of each probe to the absolute address on the record medium at the time of the instant scan of this probe, the absolute address of the instant scanning point on the record medium of each probe is computable. From the original data which were memorized to the data register and which should be recorded, the information bit corresponding to the absolute address of the instant scanning point computed respectively is read to each probe, and it records on it on a record medium synchronizing with a clock signal. Or the information bit data which each probe reproduced can be written in the bit position of the data register applicable to the absolute address on the record medium of the instant scanning point computed respectively, and original data can be reproduced. In addition, it is very effective on improvement in the speed and the cure against a noise to also integrate functions, such as a data transfer circuit with such a data register and an external device, to a recording head.

[0055] Next, a concrete example is described about the approach of tracking in the record playback approach of invention of this application 3rd. In order to look for a desired truck, in case a recording head and a record medium move relatively the detecting signal from each probe -- a truck recognition signal detector (for example, the resonance circuit which aligned with the truck recognition signal and a synchronous-detection circuit -- or) It lets it pass in circuits, such as a correlator which takes correlation with a truck recognition signal, the probe from which that output serves as max is specified, and the truck which is scanning this specified probe corresponds to the truck with which the truck recognition signal was recorded. The probe location on the recording head which can read a track address on the basis of this specified probe is computed, from that probe, a track address is reproduced and comparison collating is carried out with a desired track address. While the recording head is moving with recording head migration equipment, the probe locations which read the above-mentioned track address will differ, but since the truck recognition signal is considering as the always detectable configuration at which probe of a recording head, a track address can surely be read. Thus, recording head migration equipment is driven and the coarse adjustment of the recording head is carried out to field inboard parallel to a record-medium side until a predetermined truck is detected by the probe of one of the recording heads. The tracking of a recording head is performed by driving the jogging device of recording head migration equipment, and making field inboard move a recording head slightly so that the tracking signal output generated through the detecting signal from the specific probe (henceforth a tracking probe) used as the criteria which perform tracking in the middle of the migration after the coarse adjustment halt to the truck recognition signal detector may serve as max. It becomes possible to scan the truck top where each probe corresponds respectively by such approach on the basis of the truck with which the truck recognition signal on a record-medium side was recorded, to acquire a signal regeneration signal with a sufficient signal-to-noise ratio so, since the maximum signal output is obtained from each probe, and to record data with a precision sufficient in the location of the request on a record-medium side.

[0056] In addition, the location of the tracking probe within a recording head may make modification selection suitably by carrying out the jogging drive of the recording head migration equipment so that it may enter within the limits of the tracking probe location which can assign the data which may be fixed, should synchronize with a clock, without fixing, and should be recorded and reproduced to coincidence to each probe.

[0057] Furthermore, a concrete example is described about the approach of other tracking in the record playback approach of invention of this application 3rd. In case a recording head and a record medium move relatively, in order to look for a desired truck The middle of the recording head moving to record-medium side inboard with recording head migration equipment is sufficient, and Although the case where it has stopped is sufficient, the regenerative signal of two or more probes out of the output after letting a truck recognition signal detector pass The location in the inside of the recording head of the probe from which the maximum output is obtained is pinpointed, the location of the probe in the physical relationship which can detect a track address and a sector address on the basis of the location of this specific probe is computed, and a track address and a sector address are detected from these probes. Thus, the absolute address in the record-medium side of a specific probe is computed from the detected track address and a sector address. Based on the clock signal generated from the absolute address and the truck recognition signal of this specific probe, the absolute address on the record medium in the

instant scanning point of each probe can be computed and assigned, and original data can be reproduced based on the computed absolute address corresponding from the information bit which records the information bit corresponding to the absolute address on the instant scanning point, or each probe reproduced from the instant scanning point from the original data which were memorized by the data register, and which should be recorded. This is the approach that tracking can be performed electrically seemingly, without moving a recording head on the inside of a record-medium side mechanically as mentioned above. Especially, effective tracking can be performed when a truck minimum interval is twice [more than] the minimum pitch of the truck cross direction of a probe.

[0058] Next, the concrete example in the record playback approach in the recording device of invention of this application 2nd is explained. The distance between a recording head and a record medium is adjusted within the limits of predetermined by driving recording head migration equipment in the direction perpendicular to the field of a record medium so that the average of the signal output (tracking signal output) of the specific probe which detects a truck recognition signal may go into the range of desired. In probes other than a specific probe, each ****** equipment can be driven, the point of the probe and the distance between record-medium front faces can be adjusted within the limits of predetermined, and the output level from each probe can be arranged with coincidence so that the average of the detecting signal from the probe may go into the range of desired. Furthermore, in periods other than this review time, almost fixed record and regenerative-signal level are realizable holding the drive condition of recording head migration equipment and submigration equipment at the time of a record cycle.

[0059] Or the distance between a recording head and a record medium is adjusted within the limits of predetermined again by driving recording head migration equipment in the direction perpendicular to the field of a record medium so that the average of the detecting signal (or truck recognition signal detector output) from two or more probes may go into the range of desired. By measuring the detection output from two or more probes of the edge of a recording head with coincidence, the inclination of a recording head is corrected so that the distance from two or more points and record media of a probe may become almost equal. And the output level from each probe can be arranged by driving each ****** equipment and adjusting the tip of each probe, and the distance between record-medium front faces within the limits of predetermined so that the average of the detecting signal may go into the range of desired in each probe. Furthermore, in periods other than this review time, almost fixed record and regenerative-signal level are realizable holding the drive condition of recording head migration equipment and submigration equipment at the time of a record cycle.

[0060] Next, the approach of concrete record of the signal to the record medium using the probe of the recording device of the invention in this application and playback is explained.

[0061] First, in the case of record, induction of the electrical property of the instant scanning point of the truck on a record-medium side or the formation of a surface type status change is carried out according to the signal which should be recorded by impressing bias voltage (or bias current) between a record medium and each probe by the signal drive circuit. As an ingredient of a record medium, when phase change form record ingredients, such as for example, a GdTbFe system, a GdTbFeGe system, and a GeTeSb system, are used, the record bit from which phase transition of the crystal phase of a record medium was carried out to the amorphous phase, and resistivity changed will be written in by impressing pulse-like bias voltage (or bias current) by generating local generation of heat in an instant, and quenching immediately after that. In the case of elimination, rather than the time of record, level can be lowered, the shape of a pulse longer than the time of record and the bias voltage (or bias current) of continuation can be impressed, the rise temperature in the instant scanning point can be suppressed near crystallization temperature, it can be made to be able to crystallize by cooling slowly by relative displacement between a probe and a record medium, and a record bit (amorphous transition bit) can be eliminated. Or as an ingredient of a record medium, if aluminum vacuum evaporationo thin film material etc. is used, by impressing bias voltage (or bias current), it will oxidize, aluminum thin film will be evaporated, resistance change and surface type status change-ization will be produced, and an information bit will be recorded. In this case, it can use for an address. Moreover, in the case of

playback, pulse-like bias voltage (or bias current) is impressed between a record medium and each probe by the signal drive circuit, the signal detector where it connected with each probe electrically detects the magnitude of the current (or electrical potential difference) which flows to each probe, and a signal output is generated as compared with a threshold. The above-mentioned data processing is performed for these signal outputs, and a regenerative-signal output is obtained.

[0062] or again as an example about the approach of concrete record of the signal to a record medium, and playback In the case of record, bias voltage (or bias current) is impressed by the signal drive circuit between a record medium and each probe as mentioned above, and a record bit is recorded. In the case of playback Bias voltage (or bias current) is impressed by the signal drive circuit between a record medium and each probe, and the feedback drive of the submigration equipment fixed to each probe is carried out using a submigration equipment drive circuit so that the current (or electrical potential difference) which flows to each probe may become a predetermined value. The feedback driver voltage is considered as a signal output as compared with a threshold, the suitable above signal processing is performed for these signal outputs, and a regenerative-signal output is generated.

[0063] In addition, in explanation of an example, although explained using the concrete ingredient, the component, etc., it does not limit to these, and if the function is appropriate, it cannot be overemphasized that other objects are sufficient.

[0064]

[Effect of the Invention] As stated above, a thing with the economical remarkable effectiveness which it is possible to offer a high-speed recording device easily with super-large capacity, and is exerted on the industry by operation of the invention in this application is expected.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The mimetic diagram showing one example of the recording device which is this application the 1st or 2nd invention
[Drawing 2] The perspective view showing one concrete example of the recording head used for the recording device of invention of this application 1st
[Drawing 3] The cross section showing the example of the configuration of the beam used for the recording head of the recording device which is this application the 1st or 2nd invention
[Drawing 4] The cross section showing the example of the configuration of the beam used for the recording head of the recording device which is this application the 1st or 2nd invention
[Drawing 5] The perspective view showing one concrete example of the recording head used for the recording device of invention of this application 2nd
[Drawing 6] The cross section showing the first concrete example of the configuration of the submigration equipment which is the component of a recording head used for the recording device of invention of this application 2nd, and a probe
[Drawing 7] The cross section showing the second concrete example of the configuration of the submigration equipment which is the component of a recording head used for the recording device of invention of this application 2nd, and a probe
[Drawing 8] The cross section showing the third concrete example of the configuration of the submigration equipment which is the component of a recording head used for the recording device of invention of this application 2nd, and a probe
[Drawing 9] The mimetic diagram showing the 1st example of the record playback approach of invention of this application 3rd which looked down at the probe array of a recording head from on the record-medium front face
[Drawing 10] The mimetic diagram showing arrangement of a truck on a record-medium side, data, etc. in which one example of the record playback approach of invention of this application 3rd is shown
[Description of Notations]
1 Record Medium
2 Recording Head
3 Recording Head Migration Equipment
4 Truck
5 25 Probe
6, 13, 26, 48, 58 Beam
8 28 Signal drive circuit
9 29 Signal detector
10, 30, 43, 53 Space
11, 21, 31, 41, 51 Substrate
12, 35, 45, 55 Electrode
22, 32, 42, 52 Submigration equipment

33 49 Piezo electric crystal
56 Counterelectrode
57 Earth Electrode
61 Data
62a, 62b Track address
63a, 63b, 64b, 65a Sector address
66 Truck Train
81, 82, 83 Probe location
84 Truck Spacing
85 86 Truck

[Translation done.]

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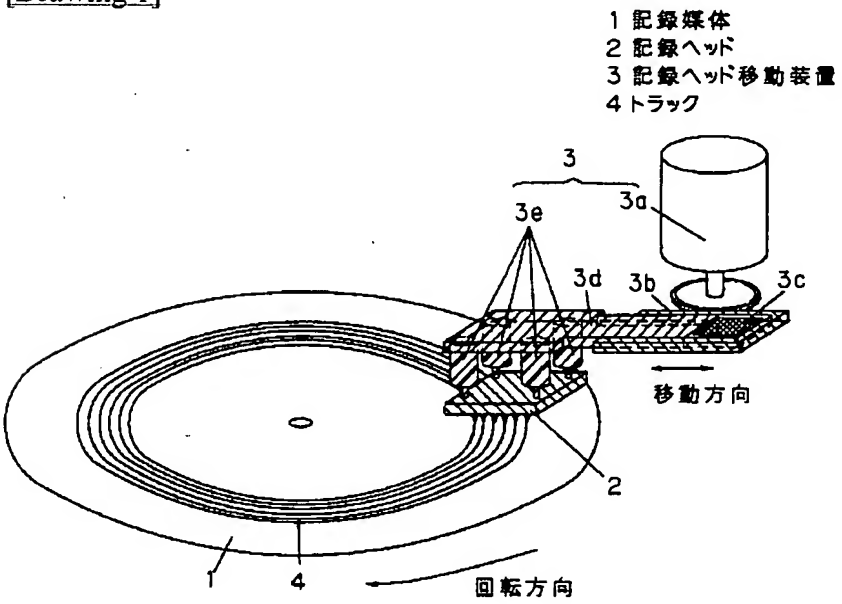
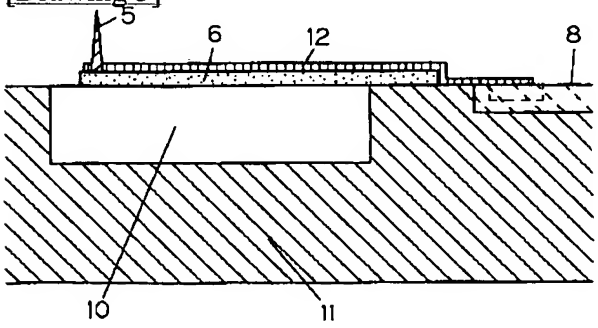
DRAWINGS

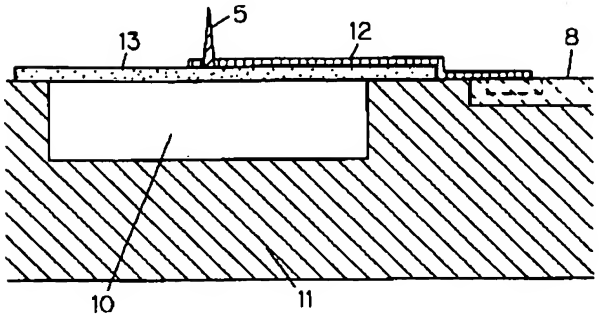
[Drawing 1]



[Drawing 3]

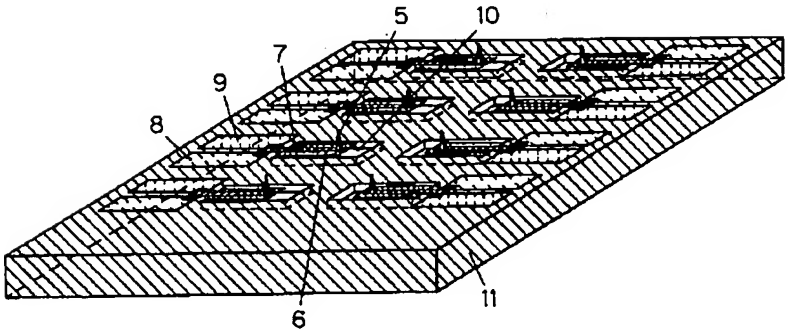


[Drawing 4]



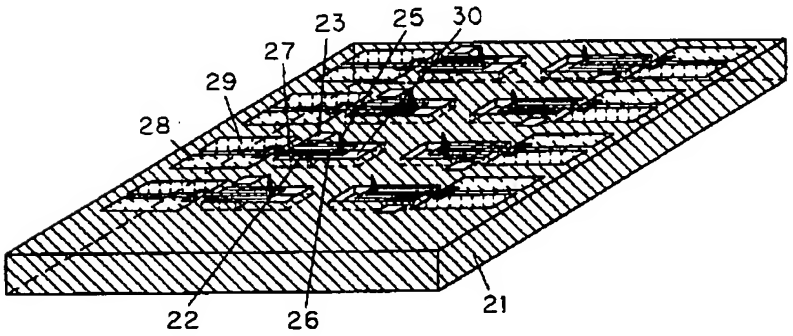
[Drawing 2]

5 探針
6 梁
8 信号駆動回路
9 信号検出回路
11 基板

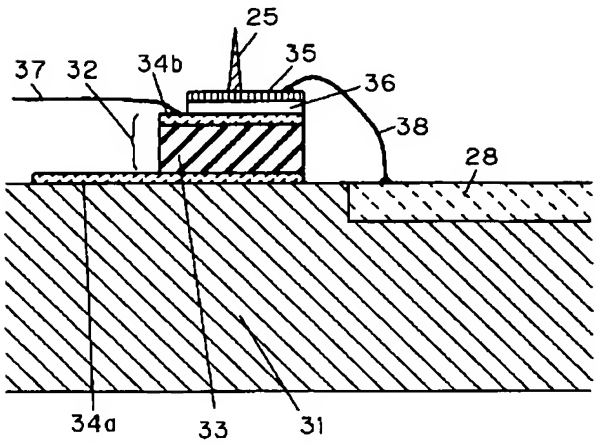


[Drawing 5]

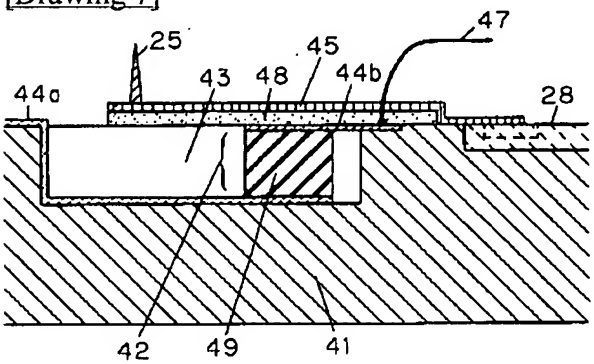
21 基板
22 副移動装置
25 探針
26 梁
28 信号駆動回路
29 信号検出回路



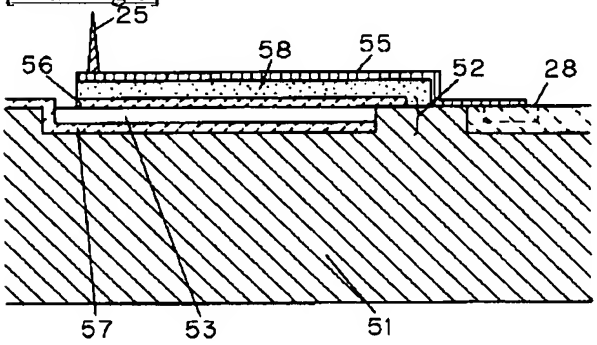
[Drawing 6]



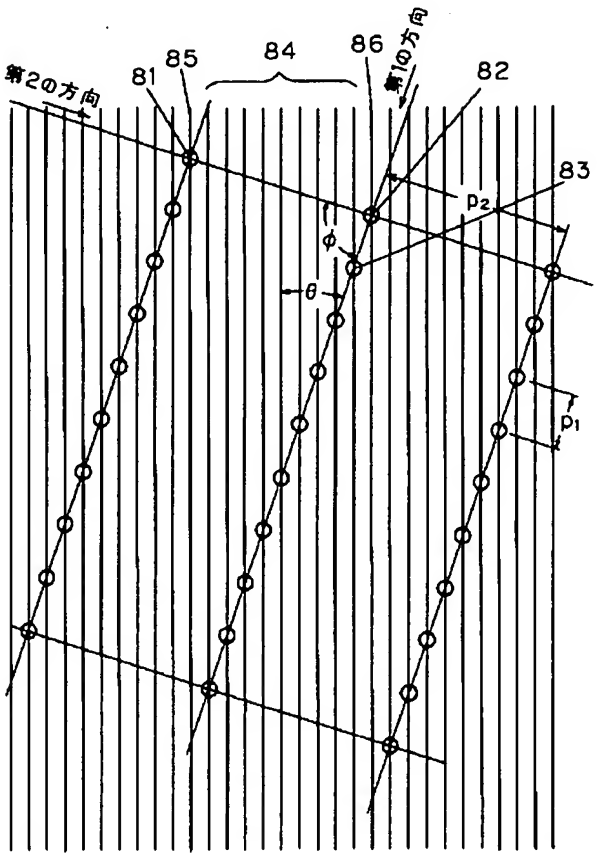
[Drawing 7]



[Drawing 8]

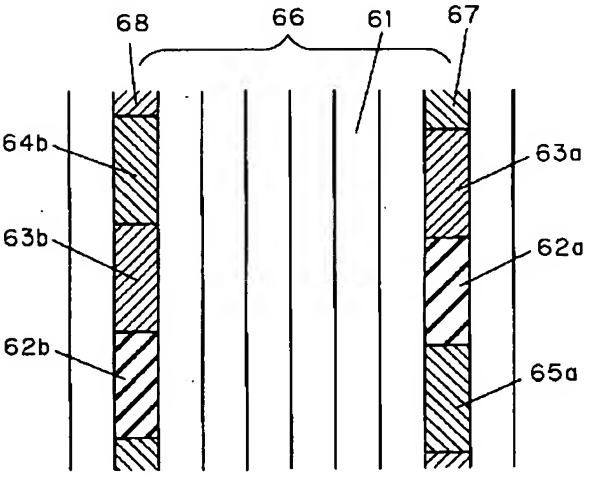


[Drawing 9]



[Drawing 10]

61 データ
62a,62b トラックアドレス
63a,63b,64b,65a セクタアドレス



[Translation done.]